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SYMPOSIUM: THE EYE IN CHILDHOOD

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M. SHUSTERMAN

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WILLIAM P. CALLAHAN

TESTING THE VISUAL ACUITY OF SCHOOL CHILDREN
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EYE INJURIES IN CHILDREN
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STUDIES ON STAPHYLOCOCCAL INFECTIONS
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INDIGENT MEDICAL CARE: THE NEEDS OF THE RECIPIENT
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The Development of the Eye

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IN very primitive animals the whole organism reacts to light. As the animal scale progresses, the light-sensitive cells become localised in the head of the organism, forming a primitive eye. In man these cells compose the delicate retina and correspond functionally to the light-sensitive film of a photographic camera. The retina is the most important part of the eye; all the other structures either nourish it, protect it or focus light on it.

In order to gain a better understanding of the normal function and common abnormalities of the human eye, one should have some knowledge of its embryology. This paper will present a very brief review of the normal development of the eye. For more details the reader is referred to the standard works listed at the end of the article.

Embryology

In simple terms, the eye is formed as an outgrowth of the primitive brain. During the second week of intra-uterine life an evagination from the forebrain somewhat in the shape of an olive, the primitive eyeball, appears and grows toward the surface ectoderm. The part of the latter structure which is in contact with the primitive eyeball begins to thicken and enlarge and gradually forms the crystalline lens of the eye. As this is developing, the apex of the primitive eyeball (just behind the developing lens) begins to invaginate and form a cup. By the sixth week of intra-uterine life this optic cup is complete, its outer wall beginning to form the pigment layer of the retina and its inner wall the remaining portion of the retina. The outer wall will eventually form, in addition, the sphincter and dilator muscles of the iris which control the size of the pupil in the mature eye. While these changes are occurring in the neural and surface ectoderm, mesoderm grows and differentiates itself around the optic cup, separating it from the lens and thereby forming the ocular structures which nourish the retina (the choroid), protect it (the sclera and cornea) and

help to regulate and focus light on it (the iris and ciliary body). In addition a vascular network forms around the developing lens.

At the end of the third month the ocular structure is easily recognized as an eye. As growth continues, the vascular capsule of the lens begins to retrogress and the avascular (adult) vitreous develops from the retina. By the end of the eighth month the vascular capsule of the lens has disappeared but frequently some vestiges remain posteriorly, dangling from the back surface of the lens, and anteriorly, attached to the collarette of the iris. These are readily seen in many adults with the slit-lamp microscope. Failure of these blood vessels to atrophy posteriorly was once thought to be the cause of retrolental fibroplasia.

Post-Natal Development

At birth the eye is relatively large, having already attained one-third of the volume of the adult eye. It is interesting to note that from birth to the adult stage the eye increases 3.25 times and the brain 3.75 times, whereas the rest of the body increases in volume twenty-one fold. The eyeball grows rapidly from birth to the age of six years, then slows down and reaches maturity in the late teens.

The antero-posterior diameter of the eye at birth is comparatively small; hence the normal infant is hypermetropic. As the eye grows to its full length the amount of hypermetropia steadily diminishes. In some individuals excessive growth occurs and myopia results. If a baby is born with an eye which is larger than normal, myopia is apparent at an early age. If the eyeball, especially the corneal portion, grows more in one diameter than another, astigmatism occurs. The factors which control the growth of the eye are unknown, but heredity does play a part.

The iris, in members of the white race, is blue at birth. Eyes of blond individuals usually remain this way throughout life. In others, mesodermal pigment is gradually laid down in the iris stroma, thus changing the colour from green to dark brown according to the density of the pigmentation.

Owing to the rudimentary condition of the accessory air-sinuses at birth, the infantile orbit is quite small in relation to the rest of the skull. Thus the two eyes are set relatively close together and this small interpupillary distance may simulate a convergent strabismus (internal squint). This false impression may be aggravated if the child has epicanthic folds—redundant skin at the root of the nose joining the upper and lower eyelids and covering part of the white sclera. If such a child looks to the side, one of his eyes will disappear partly from view underneath the epicanthus. As the bridge of the nose develops, the epicanthus usually disappears. The orbit grows fairly rapidly up to the seventh year, thereby enlarging the interpupillary distance and diminishing the pseudo-squint. The optic axes will further diverge as the accessory nasal sinuses (especially the sphenoidal and ethmoidal air cells) develop with adolescence. Sometimes in a myopic child the visual axis will pass through the outer half of the cornea and simulate the appearance of a convergent squint. High hypermetropes, on the other hand, sometimes look through the inner half of their corneas simulating a divergent strabismus.

The visual cortex of the occipital lobe of the brain begins to develop at

birth. The macula and fovea are not structurally differentiated until four months after birth but final development of central vision is not complete until about the sixth or seventh year of age, when the average child attains 20/20 vision. It is difficult to lay down visual norms since ocular development proceeds at a varying pace in normal children. The pupillary response to light and the reflex closure of the lids to bright light are usually present at birth. The movements of the eyes are irregular and independent and thus simulate a strabismus. By the age of five or six weeks, both eyes will follow a light over a considerable range for a few seconds. At three months the eyes will follow a small object, and at four months the hand will reach for the object. By the sixth month, convergence is well established. At this age the macula has developed and visual acuity then proceeds and begins to coordinate with auditory, postural, tactile and other stimuli.

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Common Eye Problems in Pre-School Children

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DURING the last decade the interest of the family physician, the paediatrician and the oculist has been focused upon the pre-school child. The urgency of the problems of prevention and early treatment has been brought forth by experience and statistical analysis.

Congenital Abnormalities

Fortunately, congenital defects, other than the defects discussed under separate headings, are rare. Congenital, partial or complete absence of the eyelids is encountered and should be repaired before school age. A drooped eyelid is a more common condition. As long as the child can see with the eye or eyes, it is not wise to correct the ptosis at an early age. The condition may improve with time, but if the drooping is still present at three years of age the condition should be corrected by an operation. The operation is best performed under general anaesthetic.

Other congenital defects, such as absence of the iris, corneal abnormalities, dislocation of the lens, absence of the choroid, and defects of the optic nerves, are also found in pre-school children. These conditions are rare, and are usually diagnosed by the paediatrician in routine examinations.

Abnormalities of Tearing

Excess tearing is a common problem in infants. Most babies have some discharge or watering of the eyes in the first few months of life, but this excess tearing usually disappears by three to four months. The usual cause of excess tearing is a blockage of the duct which drains the tears, rather than an excess production of tears. The blockage in most cases is a congenital membrane at the lower end of the canal which drains the tears into the nose. This membrane can often be broken by pressure applied over the inner side of the lower eyelid. If the tearing continues after such pressure, and the infant is four months of age, the tear duct should be opened by a probe under general anaesthesia. Frequently, blocked tear ducts which are not opened lead to infections of the conjunctiva or the lacrimal sac. Though these infections can usually be treated satisfactorily by antibiotics, serious complications can occur which are difficult to cure.

Infections

Eye infections are common among pre-school children. The condition usually manifests itself by redness of the eyeball and is commonly referred to as "pink eye". The infection may be on the surface of the eye, in which case it is known as conjunctivitis. The surface infections are satisfactorily cured by the

antibiotics. However, a red or pink eye may also be caused by an infection within the eyeball. In this case, prolonged treatment is frequently required and serious complications can occur. In all infections of the eye early diagnosis and adequate treatment are important in order to prevent complications.

Refractive Errors

Refractive errors are a common problem in pre-school children. This subject will be discussed in another paper.

Strabismus

Crossed eyes (strabismus) occur in approximately 5% of pre-school children. This topic will be discussed in another paper.

Retrolental Fibroplasia

The increased incidence of blindness in pre-school children in recent years has been caused particularly by retrolental fibroplasia. This disease was first described by Terry in 1942. The disease is confined to premature infants and almost always affects both eyes. A case in which one eye only is affected has never been encountered, some degree of the disease always being demonstrable in each eye. A recent review of the ophthalmic literature contains more than 100 articles relating to this disease. Kinsey investigated the incidence of the disease and found a wide variation in the incidence between different geographical regions and within hospitals of the same city. With regard to the weight at birth it is apparent that the lower the birth weight, the higher the incidence of the disease. Approximately 20% of the children who developed this disease progress to total blindness and require training in blind schools. Recently research workers have been able to produce a condition in the eyes of kittens similar to retrolental fibroplasia. This condition was produced by varying the oxygen of the environment of the kittens. The treatment of this disease up to the present time has been discouraging. It is hoped that the cause will soon be found so that prevention may eliminate this disease.

Congenital Cataract

The second greatest cause of blindness in children is congenital cataract. Cataract is a condition in which a part or all of the lens of the eye is opaque. Any cataract which is present at birth or appears early in life is included in the congenital group. The affected portion of the lens appears white. In some instances the cataract is familial in origin; in others it is traumatic. The occurrence of rubella (German measles) in the mother during early pregnancy is known to cause congenital cataracts. Most parents find it difficult to realize that children have cataracts because cataracts are usually associated with old age—approximately 50 cases of congenital cataract were treated at the Hospital for Sick Children during the past five years. Congenital cataracts which reduce the vision to 20/80 or less should be removed by surgery. This treatment is frequently performed on infants of four months of age. It is important to remember that the surgical results of congenital cataracts are not as good as those of senile cataracts.

Retinoblastoma

The most common tumour in children is a glioma (retinoblastoma). This tumour is frequently found at birth, and rarely occurs after ten years of age. The infant or young child affected by this disease does not complain of pain. Characteristically the first evidence of the disease noted by the parents is the appearance of a whitish reflection behind the child's pupil. This appearance suggests the luminosity of a cat's eye as seen in the dark, and the clinical picture so called, the "blind cat's eye", is regarded as characteristic of this disease. Another sign of the tumour is the turning inwards or outwards of one eye which contains the tumour. The disease occasionally shows a marked hereditary tendency. In approximately 20% of cases the disease exists in both eyes. It is well to remember that this is a malignant tumour (cancer) which spreads rapidly to other parts of the body.

The ideal treatment of this tumour would be removal of the tumour, with preservation of vision. Unfortunately this is not possible. Early treatment, which involves removal of the eye before the disease spreads to other parts of the body, is a life-saving measure.

Infantile Glaucoma

Infantile glaucoma, which is also known as buphthalmos, is a condition in which the pressure within the eyeball is increased above normal levels. This leads to stretching and destruction of the nerves of the eye. About one-third of cases are discovered shortly after birth or at least within the first year. The remaining two-thirds appear before ten years of age. As a rule the oculist is not consulted before the disease is fairly well advanced, because the disease remains unnoticed until enlargement of the eye can be detected. Enlargement of the eyeball rarely occurs in glaucoma of the adult. The condition exists in one eye only in one-third of cases, the second eye remaining unaffected. Birth marks of the face are commonly associated with infantile glaucoma.

The treatment of this disease is to lower the pressure by drugs or by surgical operation. Early treatment is imperative. The majority of cases require surgical treatment, which is best performed under general anaesthesia.

The latter four diseases which are the main causes of blindness in children emphasize the importance of early treatment. The most important early signs of these diseases are: a whitish appearance of the pupil, luminosity of the pupil, a turned eye, and an eye which is larger than normal. Early recognition and treatment of these diseases is often rewarded by the saving of useful vision.

Testing the Visual Acuity of School Children

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THE determination of visual acuity by the present methods will discover any gross visual defect. Latent defects which the individual can momentarily compensate for, but which cause unnecessary eye fatigue, may be overlooked. A clue to these latent defects may be obtained by examining the child's reading habits and inquiring if the child complains of headaches or blurred vision.

At the present time various instruments and charts are available for testing visual acuity and because of this some confusion exists as to which is the best method. Recently the Department of Ophthalmology, Hospital for Sick Children, Toronto, conducted a survey of methods used to reveal eye defects in school children.* The survey included the assessment of the different instruments used in testing vision. These included the Snellen Animal, illiterate "E", number and letter charts, the project-O-chart number, letter and illiterate "E" slides, the Bausch and Lomb Orthorator, the American Optical Sight-Screener and the Keystone Telebinocular. There was poor correlation between the different instruments in testing vision, as well as other visual functions, e.g. muscle balance. The survey revealed that the Snellen illiterate "E", number and letter charts used as herein described, are the methods best suited for visual acuity screening in school aged children.

The mechanics of taking a child's vision using the Snellen charts is relatively easy. However, it is desirable that the examiner have some preliminary instruction in vision testing, a knowledge of the common eye defects, and an appreciation of the symptoms and signs suggesting eye defects. The examination should be carried out in a moderately darkened room preferably 20 feet in length. Each child should be tested alone without the distraction of other children. The chart should be placed at eye level and the child placed 20 feet away from it. Adequate illumination of the chart is necessary and is obtained by placing a goose-necked lamp with reflector on each side of the chart and about 3 feet from it. Each lamp should contain a 100-watt daylight bulb. The examiner should briefly explain to the child what is expected of him and gain his co-operation. Each eye should be tested separately and the child asked to name the designated symbols, starting at the top of the chart. In the Kindergarten age group and for some children in the early months of Grade 1 the illiterate "E" chart will be necessary. The child indicates to the examiner, by means of a piece of cardboard or wood cut in the shape of an E, the position of the arms of the "E" symbol that can be seen on the chart.

The following recommendations are included for the guidance of those testing vision in schools.

1. The Snellen illiterate "E" chart is an adequate test for visual acuity in the Kindergarten age group. A visual acuity of 20/30 in each eye can be regarded as normal. Children with visual acuity poorer than 20/30 in either eye should be referred for eye consultation.

2. The Snellen number chart is an adequate test of visual acuity in Grade 1 and the Snellen letter chart is adequate for children in Grades 2 to 13. In Grades 1 to 13 a visual acuity of 20/20 in each eye can be regarded as normal. Children with vision poorer than 20/30 in either eye should be referred for eye consultation.

3. Faulty reading habits, including fatigue after reading for short periods, and the complaints of headache or transient blurred vision may be indications of latent eye defects *despite normal visual acuity*. Children in this category should be referred for eye consultation.

The determination of a child's vision is a necessary part of any comprehensive public health program. This examination should be made in the first year of school, whether this be Kindergarten or Grade 1, and at three-year intervals thereafter. These intervals would necessarily be shorter if the child wears glasses or complains of any difficulty with reference to his eyes.

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*Canad. M.A.J., *67*: 29, 1952.

Strabismus Should Not Be Neglected

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CROSSED eyes can be corrected at any age, but the best results are obtained before school age is reached. A cross-eyed child may develop a psychological complex because he is different from his friends and for this reason alone treatment should not be delayed. In addition, the chances of developing good binocular vision are better if treatment is started early, as the vision often deteriorates in the turned eye. If there is any doubt in the observer's mind, the child should be referred for investigation. It is even dangerous to neglect crossed eyes in a baby, as the first sign of a malignant ocular tumour may be a turned eye. Unfortunately, in some areas the ophthalmologists delay treatment until the child is five or ten years of age. In view of this a special effort is being made to educate the medical profession about the importance of advising early treatment. The problem of strabismus is being investigated at the Hospital for Sick Children with the aid of a Federal Health Grant. Approximately 1,000 cases a year have been investigated and treated since the project began. Each case is thoroughly investigated to determine the cause.

Method of determining if a child's eyes are crossed

Most babies do not co-ordinate their eyes in the first few months but they should be using both eyes together at six months. Some children are born with crossed eyes and others become apparent in the first few years of life. A few cases straighten but the majority require some type of treatment. Some cases are very obvious, but in others the eye turns only when the child is tired or sick. A history should be obtained from the parents to determine if they have noticed the eyes turning at any time. An easy way to determine if the eyes are straight is to hold a light in front of the child's eyes and in front of the observer's eyes and observe the light reflex in each pupil. If the child's eyes are straight, the reflex should be in the same position in both eyes. If they are not, it is quite possible that the eyes are turned.

Treatment

Atropine is instilled to dilate the pupils and relax the muscles. If the eyes straighten with atropine, it usually indicates that glasses will hold them straight. The refractive error can easily be determined by retinoscopy even at an early age when the pupils are dilated. Glasses can be started at a year of age and babies will wear them readily if their eyes require them. If glasses are not indicated or if they do not straighten the eyes, an operation should be done, and it can be done at any age. The majority of patients at the Hospital for Sick Children are operated on under the age of four, and the eyes certainly should be straightened before school age. The operation is a delicate one but

it does not affect the child very much, and with the modern anaesthesia methods there is little danger connected with the operation. The patient is usually allowed to go home a day or two following the operation, without a dressing on the eye. Occasionally a second operation is necessary. If treatment for the crossed eyes has not been started until the child is four or five years old, good results are more difficult to attain. At this stage usually some type of orthoptic training is necessary. This consists of eye exercises given by a trained orthoptist. Sometimes it is necessary to cover the good eye to improve the vision of the turned eye. Exercises alone will not usually straighten the eye but must be used in conjunction with surgery. Following the operation a series of exercises is sometimes necessary and the child may achieve *binocular* vision, good vision with both eyes. Even if the eyes do not completely co-ordinate, or if one eye is defective, most children are not handicapped in any way. Many adults have achieved fame and done very important work with only one eye.

Conclusion

Best results in the modern correction of crossed eyes are obtained when treatment is started as soon as the condition is noticed.

Refractive Errors in Children

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RAYS of light passing from one medium (for example, air) to another medium of a different density (for example, glass) are bent. This bending of the light rays is known as refraction. We have all refracted (bent) the parallel rays of light from the sun by holding a convex lens of glass in such a manner as to focus these rays on a piece of paper and burn a hole in it. The eye is made up of transparent media which refract the light rays entering it and focus them. Thus we may compare the eye to a camera. There is a clear, watch-glass-like window at the front known as the cornea. Light rays enter the cornea and pass backwards through the pupil, which is a small hole in the centre of the coloured iris. This hole varies in size just as one varies the lens opening on a camera for various light conditions. The rays then pass backwards through the lens of the eye. The lens can alter its shape to focus objects far away or up close. In a camera, this focusing of its lens is achieved by moving the lens out or in. The light rays pass further backwards through the clear jelly, inside the eye, to focus finally on the sensitive retina. The retina may be compared to a very sensitive film. It records the picture seen and passes it back by nervous impulses along the optic nerve to the back of the brain. This area of the brain is responsible for developing the picture so that we may appreciate it.

When the rays of light are refracted in the eye by the cornea, lens, and fluids so as to bring them to a clear focus on the retina, sharp clear vision is appreciated. When, however, these media do not refract the rays of light normally, or when the retina is too far forward as in a short eyeball, or too far back as in a long eyeball, then the light rays do not come to a sharp focus on the retina and blurred vision occurs. When the focus occurs in front of the retina, as in a long eyeball, short-sightedness or myopia results. When the focus occurs behind the retina, long-sightedness or hypermetropia results. When the rays coming in at one meridian focus at a different point from those at an opposite meridian, we have the condition known as astigmatism. Astigmatism can be of the short-sighted or long-sighted variety or a mixture of both.

Refraction of an eye is done to correct these abnormal conditions by placing lenses before the eye which will compensate for short-sightedness, long-sightedness or astigmatism, focus the light rays on the retina, and restore clear normal vision. To do adequate refractions in children we believe the muscles controlling the lens and iris should be paralyzed. We do this by instilling drops or ointments in the eyes before refraction.

The eyes of children are smaller than in adults and thus most children are far-sighted. As the eyes grow, this far-sightedness becomes less and by maturity a normal state usually results. However, the eye may grow larger than normal and the child will then become short-sighted, usually between the ages of 8 and

12 years. This short-sightedness will tend to increase during the child's growing years until maturity is reached. We do not feel that eye exercises are of help in controlling myopia.

Far-sightedness is the common finding in young children. Most babies are quite far-sighted. The muscles inside the eyes can change the shape of the lens to overcome this far-sightedness and still give the child clear normal vision. The work entailed in changing the shape of the lens may cause symptoms of eye strain, inattentiveness and dislike for reading and school. Styes, red lids and chronic low-grade infections may result. Proper glasses will usually remedy this state. Since the eye is changing from year to year, an annual refraction is recommended. It should be pointed out that these children may have normal distant vision, but still have symptoms and require glasses.

Short-sightedness, as stated above, tends to appear between 8 and 12 years of age. Distant vision becomes blurred, the child does not see the writing on the blackboard plainly, and has to be moved up to the front of the class. He squeezes his eyelids together to attempt to see more clearly and becomes more and more interested in reading (a book-worm) and less and less interested in sports and outdoor activities. He thus develops introverted tendencies. These children do not as a rule complain—they accept their near-sightedness and spend their time reading. They are picked up by the Public Health nurse or teacher with the routine vision test and are referred for refraction. Proper glasses are ordered and the child moves back into society. These children should be rechecked every six to twelve months to keep their glasses of proper strength, as the short-sightedness tends to increase during their growing years.

Astigmatism usually interferes with both distant and near vision. These children may complain of eye strain. Again observation in the classroom and regular vision retesting by the nurse or the teacher will usually uncover a defect. Referral to an eye specialist for examination should follow. If glasses are prescribed, further re-testing or re-examination should be as suggested by the specialist.

Babies and pre-school children are refracted because the parents have noticed some difficulty in their seeing, or because they have a crossed-eye, or because another member of the family has had eye trouble. Proper glasses are ordered starting at about 12 or 14 months in an attempt to have the baby develop normal vision or to straighten his eyes. In these young children atropine should be instilled in the eyes for two or three days before refraction. They require rechecking by an eye specialist every 6 to 12 months.

The school age groups require homatropine instillation in the eyes before refraction only on the day of the test. Vision should be brought up to normal and kept there with proper glasses and then the eyes should be treated as normal eyes. There is no need to seat the short-sighted children up front. They should be allowed to read like their friends provided they have a good light and keep the book 15 inches from the eyes. They may go to the theatre, and watch television, and should be encouraged to take part in sports and all activities. Television has been found useful in exercising lazy eyes. It may bring defects to the fore, but has not been found harmful to the eyes.

The glasses ordered are surface-hardened, a process which hardens the glass

and makes it much less likely to break and injure the eyes. We prefer shell frames because they have more "give" to them, and are less likely to get out of proper adjustment. Contact lenses are not recommended for correction of refractive errors in children.

Factors governing the type of refractive errors to be found in children are many. Racial origin is important. Myopia, for example, is much more common in Japanese, Chinese and Jewish than in British or American stock. Heredity certainly plays a part. Myopia may occur in several members of the same family. Debilitating illnesses, poor hygienic surroundings, reading in bed and reading in poor light, are thought by some to weaken the outer coat of the eye and lead to an increased incidence of myopia.

Summary:

1. Children should be watched for signs and symptoms of eye defects such as headaches, lassitude, inattentiveness, red lids and styes.

2. Their vision should be tested regularly at school (on entrance and at least every three years thereafter), because most children do not complain or present obvious signs of eye weakness.

3. Where indicated, they should be referred to the eye specialist for examination, and the prescribing of safe, comfortable, attractive glasses. The glasses should be worn as the specialist advises.

4. The parents should take the children back for re-examination by the eye specialist as advised by him.

5. Children with glasses should be considered as having normal eye function unless otherwise stated, and should be allowed to take part in all the activities afforded their classmates.

Eye Injuries in Children

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EYE injuries in children do not appear to be increasing, but since accidents of various kinds cause about 50% of all blindness in one eye and about 20% of all blindness in both eyes, early proper treatment is extremely important. The various eye injuries and their treatment may be discussed under the following headings: (1) Contusions; (2) Extra-ocular and intra-ocular foreign bodies; (3) Lacerations of the lids and globe; and (4) Burns.

1. Contusions

Injuries by blunt objects may vary in severity from a simple corneal abrasion to rupture of the globe. Any part of the eye may be so injured by contusion so as to seriously diminish vision. In some cases the changes are progressive, so that in all cases a guarded prognosis should be given. The various conditions which may follow contusion will be briefly enumerated.

Cornea: A simple abrasion may occur. It is recognized by a roughening of the cornea, and when a drop of 1% fluorescein solution is placed inside the lower lid by the physician, the abraded area takes up a greenish-yellow stain. There is much pain, such as produced by a foreign body, increased on moving the lids, and tearing; and patients keep their lids forcibly closed. In most cases the instillation of an antiseptic or antibiotic eye ointment, and a tight eye pad to splint the lids, suffices.

Hyphaema, or blood in the anterior chamber, is frequently seen in children. Children with this condition should be put to bed and kept quiet for several days until the blood absorbs. In preventing further haemorrhage it has been our experience at the Hospital for Sick Children that the children are kept more quiet by covering both eyes and kept in bed. If the haemorrhage has been massive, there may be a resultant glaucoma which may lead to blood staining of the cornea. In these cases it may be necessary to evacuate the blood by operation (paracentesis, and irrigation of the anterior chamber).

Iris: Contusions to the eye may cause the pupil to become large and immobile, and it may remain moderately dilated permanently. Iridodialysis (the iris being torn away from its roots for a variable distance), apart from other injury, rarely causes serious results and may not even impair vision. Contusions over the ciliary body may cause diminution in the focusing ability of the eye due to paralysis of the ciliary muscle.

Hypotony or low intraocular pressure may follow a blow, due to interference with the functions of the ciliary muscle.

Lens: Rupture of the suspensory ligament may cause dislocation of the lens. This may be diagnosed by tremor of the iris (iridodonesis) on movement of the

eye. If the capsule of the lens is torn then cataract results. Secondary glaucoma may result from either of the above two conditions.

Choroid: Rupture of the choroid occurs as a result of severe contusion. This is seen through an ophthalmoscope as a curved white streak not far from the disc and concentric with it. This usually occurs on the outer side of the disc, and if the macula is involved, loss of central vision results.

Retina: Haemorrhages into the retina occur and may extend into the vitreous. Detachment of the retina is common after contusion, Commotio retinae, or a swelling in the retina at the point of best vision (macula), may result from a blow on the eye. It disappears after several days and vision is usually restored to normal.

Treatment of most of the above conditions is rest. In the case of retinal detachment, operation is required; this consists of diathermy burns to the adjacent sclera to set up aseptic inflammation to provide adhesions and attachment of the retina. Evacuation of the fluid under the retina may be necessary.

2. Extra-ocular and Intra-ocular Foreign Bodies

In most cases small metallic or other foreign bodies are seen on the anterior surface of the cornea. These are removed by the physician by first instilling a drop of 1% butyn or ½% pontocaine. A small piece of cotton wrapped tightly on the end of a toothpick may be tried and if this is not successful a hypodermic needle or a spud may be used. If there is any loss of the surface layers of the cornea as evidenced by staining with fluorescein, the application of antiseptic eye ointment, with a tight pad, should be carried out. Foreign bodies frequently become adherent to the back of the upper lid, so that the lid should routinely be everted and examined.

Particles of steel, stone, glass, etc., may penetrate the eyeball. Careful examination of the eye with the slit-lamp and corneal microscope may reveal the path of the foreign body. Radiographs of the orbit are frequently helpful. Eye injuries from BB-guns are frequently seen at the Hospital for Sick Children. If the pellet has traveled a long distance, or has ricochetted from another surface, or hit the eye from a very oblique angle it may produce little damage. If the eye is hit from a shorter distance, the globe is frequently penetrated, or the pellet may lodge in the orbit outside the globe.

Treatment: Foreign bodies should be removed as soon as possible. If they are magnetic metals, giant magnets frequently help in their removal. Every attempt should be made to educate the child to the dangers of air rifles, and protective goggles should be worn in manual-training classes where grinding or sanding is being done.

3. Lacerations of the Lids and Globe

The successful treatment of eye injuries depends very much on the first-aid care. If the wounds are exposed, sterile dressings are essential and the areas must be protected from further injury on the way to the hospital.

When confronted with any injury of the eyelid, care should be taken to

exclude injury to the eyeball itself. The orbital walls should also be examined for possible damage. A "sinking in" of the eye suggests fracture of the roof of the maxillary sinus or orbital floor, with sinking of the orbital contents.

Repair of lacerations of the lids should be done during the first few days after an injury, because the defects are easily repaired with no deformity at the time of the injury, whereas later they are difficult to correct and are associated with severe deformity.

Lacerations of the tear duct require early surgery if the cut ends are to be joined together.

Lacerations of the eyeball itself need immediate treatment, and the prophylactic treatment is aimed at preventing further injury.

The injured eye should be immobilized to prevent herniation of the ocular contents. This can be best accomplished by covering both eyes. Any manipulation of a recently injured eye causes pain with squeezing of the lids and extensive herniation of ocular contents.

Such examination should be deferred to the ophthalmologist who will do it under good anaesthesia with proper lighting and good instruments. Chemotherapy and antibiotics should be started early to prevent infections which may cause permanent damage to the eye.

Tetanus toxoid should be given if the laceration extends into the eyeball. In the management of wounds over the ciliary body, with or without incarceration of this structure, good judgment is required.

The prognosis must always be guarded, although the outcome can be surprising. The threat of sympathetic ophthalmia (a condition where the uninjured eye may become inflamed following injuries to one eye, and the second eye may even go on to blindness) is always of concern. The best prognosis is afforded by clean wounds with no incarceration of the ciliary body and little or no vitreous haemorrhage. Sympathetic ophthalmia rarely occurs before two weeks after the injury. Eyes in which the indication for enucleation is doubtful can therefore be observed safely for that length of time.

4. Burns and Injuries by Caustics

Injuries to the cornea and conjunctiva by these agents are detected by the instillation of a drop of fluorescein into the conjunctival sac. A greenish color is taken up by the injured tissues.

First-aid treatment consists of copious washing with water. This could be done by holding under a tap the child's head with the lids of the involved eye held open. No neutralization of the chemical should be attempted, for it has been proved that this procedure is unsatisfactory, and in some cases is actually harmful. In hospital the eye is anaesthetized with some non-narcotic local anaesthetic. Pontocaine or butyn is very satisfactory. As soon as the pain is controlled, the eye should be inspected for particles inside the lids and all these should be removed.

If after all foreign material has been removed there is any residual staining with fluorescein, the eye should be covered with a snug eye patch and referred to an ophthalmologist.

Studies on Staphylococcal Infections

III. Some Epidemiological Aspects and Bacteriophage Typing

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NUMEROUS workers have been confronted with the difficult task of classifying and differentiating strains of *Micrococcus pyogenes* var. *aureus*. To achieve this purpose, two main methods have been widely used in order to permit recognition of stable types within this species. One notable serological approach (1), based on precipitation of polysaccharide cellular extracts by homologous sera, permitted the distinction of two types: the pathogenic Type A and the saprophytic type B. A further advance was achieved by Blair and Hallman (2), in 1936, and Cowan (3), in 1939, who divided Julianelle's type A into three types, 1, 2 and 3, by means of a slide agglutination technique and absorbed sera. In 1940, Christie and Keogh (4) reported the finding of nine sub-types of pathogenic staphylococci. The application of Cowan's method by Goyle and Minchin (5) in India, who were able to type only 33% of their strains, indicated the need of determining other new sub-types before serological typing could be used advantageously in epidemiological surveys. Recently, in January, 1954, Oeding (6) in Norway, using single factor sera, reported that 94.7% of his 854 strains could be classified into 9 serological groups subdivided into 4 major and 5 minor groups. If such results are corroborated elsewhere, this method of antigenic analysis should furnish a practical means of typing *M. pyogenes* var. *aureus*.

In recent years, methods of typing *Staphylococcus aureus* by means of bacteriophages have been devised. This was initiated by Burnet and Lush (7), in 1935, and Fisk (8, 8a) in 1942, by isolating from *S. aureus* phages which appeared to be type-specific. In 1945, Wilson and Atkinson (9) described a modification of Fisk's method of isolation and propagation of bacteriophages which could be applied in routine typing. Their technique, from many points of view, is very like the method of Craigie et al. (10) for typing *Salmonella typhi*, but instead of only one phage, as used with typhoid organisms which give type-specific lytic reactions, 21 phages isolated from different strains of *S. aureus* are applied on cultures to be examined, which give complex patterns of lysis and permit classification. These observations prompted workers such as Williams and Rippon (11) to report their results in "phage patterns" and Blair and Carr (12) as "phage groups."

This method of phage typing has been extensively used in Great Britain and Australia (9, 11, 13, 14, 15, 16, 17, 18a, 18b, 19) for epidemiological studies

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of hospital cross-infections, food-poisoning outbreaks, etc. In other countries, relatively few investigators have taken advantage of staphylococcal phage typing: Wahl and Lapeyre-Meusignac (20a, 20b) in France; Wallmark (21), Vogelsang (22), Oeding and Vogelsang (23) in the Scandinavian countries; Fisk and Mordvin (24), Fisher (25), Blair and Carr (12), Dowling, Lepper and Jackson (26), Fusillo et al. (27) in the United States; McClure and Millar (28), Colbeck (29), Denton, Kalz and Foley (30), Saint-Martin, Charest and Desranleau (31) in Canada.

The purpose of this paper is to present a complete report on staphylococcal bacteriophage typing as performed at the Division of Laboratories of the Quebec Ministry of Health since 1948 on numerous cultures isolated from clinical cases of infections and from healthy carriers of *S. aureus*. The results obtained will be analysed in terms of phage-types, phage-patterns and phage-groups. Some comments will be included upon the incidence of types found in clinical cases and among penicillin-resistant and penicillin-sensitive staphylococci isolated from healthy carriers. The method of propagation and conservation of phages as used in this laboratory will be described in detail.

Material and Methods

Cultures

A total of 2,370 strains of coagulase-positive staphylococci were examined from which 998 were isolated from patients in hospitals: 464 in Montreal; 397 in Quebec City; 137 in other Provinces and in the United States. The remaining 1,108 cultures were isolated from children considered as healthy carriers (32). Type strains for propagating phages are kept on tryptose agar slants and transferred every three months.

Phages

The first series of phages and propagating strains used for typing were supplied in 1948 by Dr. V. D. Allison of the Staphylococcal Reference Laboratory, London, England. These include phages 3A to 52A of Table I. Phages 53 and 54 and propagating strains were sent to us in 1952 by Dr. R. E. O. Williams from the same laboratory. Phage P-68 was received in 1952 from Dr. R. Wahl of the Pasteur Institute, Paris. Phage W (Winnipeg) was received in 1949 from Dr. J. C. Colbeck, formerly Director of Laboratories, Department of Health of Manitoba. Phage Q-230 was identified in 1951 by one of us (I.M.) from a culture isolated from the draining ear of a 6-month-child by Dr. F. H. Prissick of the Children's Memorial Hospital, Montreal. None of these phages were heated or filtered but were propagated and kept according to the following method outlined by one of us (J.-M. D.) in 1948.

Media

Nutrient agar

Bacto-nutrient Broth	20 g.
Bacto-Agar	15 g.
Glycerol	50 g.
NaCl	7.5 g.
H_2O	1000 ml.
pH	7.5

Buffered Tryptose Glycerolated Broth

Bacto-Tryptose	20 g.
NaCl	8.5 g.
Na_2HPO_4	10.1 g.
KH_2PO_4	1.4 g.
(Glycerol	245 ml.)
H_2O	755 ml.

Propagation

The original concentrated phage is tenfold-diluted in Buffered Tryptose Broth without glycerol and applied on homologous propagating strain inoculated by circular areas of 20 mm. with platinum loops on nutrient agar according to the method of Craigie (33) for typing of *S. typhi*. One plaque is transferred to broth, concentrated by adding a small amount of culture, incubated for 3 to 4 hours at 37° C., and a loopful (0.02 ml.) is applied on each of 6 or more areas of culture on 5% glycerol nutrient agar. Plates are incubated for 5 hours at 37° C. and placed at 6–10° C. overnight. The agar of 6 lysis areas (complete lysis) is cut and put into 15 ml. of 30% glycerol-tryptose broth buffered at pH 7.5; the tubes are well shaken and stored in the refrigerator for at least one month, in order to permit stabilization of the phage preparation.

Titration

The critical test concentration (C.T.C.) of this concentrated phage is determined exactly by the same technique with tenfold dilutions in tryptose broth without glycerol of the concentrated phage previously centrifuged at 2000 r.p.m. for 30 minutes. For accurate determinations, twofold dilutions of the last tenfold dilution producing confluent lysis are tested. The highest dilution giving confluent lysis is then used for routine typing and for testing cross-reactions between phages on the propagating strains.

The C.T.C. of phages prepared by this method varies from 10^{-2} to 10^{-5}. This concentration has to be checked at least once a month, because diluted phages have a tendency to weaken more or less rapidly whereas concentrated stock phages kept in the refrigerator are, in our experience, stable. None of the phages have been lost since 1948.

The cross-reactions between the available 26 phages on the propagating strains are given in Table I. These reactions are very similar to those reported by Williams and Rippon (11). The notation used in our table is exactly the same as the one used in typing *S. typhi*. In our laboratory, the main lines of Craigie's technique are followed for phage typing *S. typhi*, *S. paratyphi B* and *Micrococcus aureus*, and it has been found more convenient to use the same notation to express different degrees of lysis whatever may be the organism to be tested and the phages to be used.

The scheme of Table I has been used to report our findings on testing unknown cultures for type by comparing the lysis obtained with the reactions of propagating strains with phages. In many instances, it has been possible to assign to a strain a given denomination represented by lysis by only one phage but, in many instances, this was impossible because of too many cross-reactions between two or more phages. In these cases, type denomination was very

TABLE I

BACTERIOPHAGE TYPING OF STAPHYLOCOCCUS AUREUS

Phage Preparations at the C.T.C.

Strain No.	3A	3B	3C	6	7	29	29A	31	42B	42C	42D	42E	44	44A	47	47A	47B	47C	51	52	52A	53	54	W 230	P-68
284	CL	+n	+n	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+n
211	—	CL	CL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1339	—	++m	CL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	CL	15n	—	—	—	15n	—	—	5n	—	—	CL	—	10n	10n	—	—	—	SCP	CL	—	—
4	—	—	—	5n	CL	—	—	—	—	—	—	—	—	—	5n	—	—	—	—	—	—	+n	10n	—	—
33	—	—	—	—	—	CL	—	+n	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+++n
1351	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18*	—	—	—	—	—	15n	+n	CL	—	—	+n	—	CL	+++m	—	—	—	—	—	—	—	—	—	—	—
1163**	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—
1307	—	10m	—	—	—	—	—	—	—	CL	15n	—	—	—	—	—	—	—	—	—	—	—	—	—	++n
1363	—	—	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1670	—	—	—	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—	—	—	—	—	15n
373	—	—	—	—	5m	—	—	—	—	+m	—	—	—	CL	—	—	—	—	—	+n	20n	—	—	—	30m
36	—	—	—	—	—	5n	10n	—	—	—	—	—	—	—	CL	—	20m	+m	—	—	—	+++m	15n	—	SCP
761	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—	+++m
987	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—
145	—	CL	CL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	+n
144	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	+m	—	—	—	+n
925	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	15n	CL	—	—	—	—
R-3292	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	+++n	—	20n
R-3303	—	—	—	—	10n	—	—	—	—	10n	—	—	10n	—	CP	—	+m	++m	—	—	—	SCP	CL	—	20n
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	—
Q-230	++m	—	5m	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+n
374	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	CL	—	—	—	—	—	—	—	—	CL

*: Phages 31 and 44 propagated on Strain 18
**: Phages 42B and 47C propagated on Strain 1163
CL: Complete Lysis
CP: Confluent Plaques
SCP: Semi-confluent Plaques

n or m: Normal or Minute Plaques
+: Slightly Numerous Plaques
++: Numerous Plaques
+++: Very Numerous Plaques

TABLE II

BACTERIOPHAGE TYPING OF STAPHYLOCOCCUS AUREUS

Group I

Phages: 29; 29A; 31; 44; 44A; 52; 52A

Number of strains: 549

TYPES

29		29A		31		44		44A		52		52A	
Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains
29	*98*	*29A*	*29*	*31*	4	*44*	*8*	*44A*	*10*	*52*	*161*	*52A*	*30*
29/29A	3	29A/44A	1	0.17%		44/44A/P68	1	0.42%		52/W	1	1.26%	
29/P68	14	29A/P68	1				—			52/P68	50		
29/29A/P68	1		—			0.34%				52/P68/W	7		
29/31	2		31				9			52/52A	48		
29/29A/31/P68	4	1.31%								52/52A/P68	13		
29/31/53	2									52/52A/P68/W	4		
29/29A/31	1									52/29	28		
29/31/P68	1									52/29/29A	11		
29/29A/31/53/54	1									52/52A/29	5		
	—									52/29/P68	4		
	127									52/52A/29/7/W/P68	3		
5.35%										52/52A/29/29A/31/ 44/44A/53	3		
											—		
											338		
										14.25%			

Group II
Phages: 3A; 3B; 3C; 51

Number of strains: 236

TYPES

3A		3B		3C		51	
Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains
3A	*49*	*3B/3C*	*157*	*3C*	*14*	*51*	*1*
3A/P68	7	3A/3B/3C	1	3C/P68	4	51/3A/3B	1
	56	3B/3C/P68	2		18	51/3A/3B/3C	1
			160				3
	2.32%		6.65%		0.76%		0.13%

Group III
Phages: 6; 7; 42B; (42C); 42E; 47; (47A); 47B; 47C; 53; 54

Number of strains: 619

TYPES

6		7		42B		42C		42E	
Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains
6/47	*131*	*7*	*1*	*42B/47C/P68*	*88*	*42C*	*35*	*42E*	*1*
6	8	7/54	1	42B/47C	15	42C/42D	10		
6/47/47C	1	7/42C/42D/54	1	42B/P68	5	42C/P68	5		
6/47/53	8		2		108	42C/42D/P68	3		
6/47/54	6		3			42C/42D/42E/P68	2		
6/47/53/54	8		0.13%		4.55%	7/42C/42D/P68	1		
6/7/47/53/54	2						56		0.05%
6/47/47C/29A	1						2.36%		
Any pattern + P68	6								
6/31/47/47B/47C/52/52A/54	1								
	172								
	7.25%								

TYPES

47		47A		47C		53		54	
Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains
47	*94*	*47A*	*1*	*47C*	*63*	*53*	*7*	*47/53/54*	*10*
47/47A/47B/47C	1	0.05%		47C/P68	65	53/P68	4	54	1
47/47A/47B/47C/53/P68	1				128	53/54	3	7/47/47B/53/54/P68	1
47/47C	1			5.4%			14	47/53/54/P68	3
47/53	8					0.41%		7/47/53/54	1
47/53/P68	5								16
47/54	8							0.68%	
47/54/P68/W	2								
	120								
5.05%									

Group IV		Other phages				Untypable (no lysis)	Typable
Type 42D		Q230		P68		No. of strains	No. of strains
Patterns	No. of strains	Patterns	No. of strains	Patterns	No. of strains	649	1721
42D	*38*	*Q230*	*20*	*P68*	*257*	27.4%	72.6%
42D/P68	1	Q230/P68	1	10.85%			
	39		21				
1.81%		0.8%					
		Number of strains: 278				Total number of strains examined: 2370	

difficult and could be made only by comparing the reactions of phages giving the stronger lytic reactions. For example, strains lysed by phage 29 only were labelled type 29; those lysed by phage 29A only were classified as type 29A, but strains lysed by both 29 and 29A phages were designated as type 29. With certain strains, the reactions were much more complex, as can be seen in Table II. In such cases, the complete pattern of lysis must be given.

Results

Table II shows the general distribution of staphylococcal phage types of the 2,370 strains examined, of which 649 or 27.4% were untypable (no lysis) and 1,721 or 72.6% were sensitive to the phages available. It must be pointed out that 255 strains which were not sensitive to the phage preparations at their C.T.C. were typed by using phages 100 times more concentrated. Our results are given in terms of "phage groups", "phage types" and "phage

TABLE III

Phage Typing of Staphylococci Isolated from Patients in Hospitals

Group	Phage Type	Montreal		Quebec		Canada (outside of Que.) and U.S.A.		Total of strains	Per cent of typed strains
		No. Typed	Per cent of typed strains	No. Typed	Per cent of typed strains	No. Typed	Per cent of typed strains		
I	29	8	2.4	14	3.9	2	1.8	24	2.4
	29A	1	0.3	—		—		1	0.1
	44	—		—		2	1.8	2	0.2
	44A	—		2	0.5	1	0.9	3	0.3
	52	51	15.1	56	15.6	10	0.	117	11.7
	52A	5	1.5	—		4	3.5	9	0.9
	Total:	65	19.2	72	20.	19	16.8	156	15.6
II	3A	6	1.8	—		6	5.3	12	1.2
	3B	22	6.5	6	1.7	2	1.8	30	3.
	3C	2	0.6	8	2.2	—		10	1.
	51	—		—		1	0.9	1	0.1
	Total:	30	8.9	14	3.9	9	8.	53	5.3
III	6	44	13.0	16	4.5	26	23.1	86	8.6
	7	—		2	0.5	—		2	0.2
	42B	46	13.6	23	6.4	14	12.4	83	8.3
	42C	2	0.6	1	0.3	1	0.9	4	0.4
	42E	—		—		1	0.9	1	0.1
	47	80	23.6	8	2.2	15	13.3	103	10.3
	47A	1	0.3	—		—		1	0.1
	47C	34	10.	64	17.8	6	5.3	104	10.4
	53	5	1.5	1	0.3	8	7.1	14	1.4
	54	2	0.6	1	0.3	9	8.0	12	1.2
	Total:	214	63.5	116	32.4	80	70.7	410	41.
IV	42D	5	1.5	2	0.5	—		7	0.7
Other Phages	P68	22	6.8	155	43.2	4	3.5	181	18.1
	Q230	2	0.6	—		1	0.9	3	0.3
	Total:	24	7.1	155	43.2	5	4.4	184	18.4
Untypable	No lysis	126		38		24		188	18.8
	Total:	464		397		137		998	

patterns". Strains lysed only by phage Q-230 or by Wahl's phage P-68 are listed separately in a miscellaneous group.

More than half of the organisms typed fell into Group III (36%) and Group I (31.8%). Smaller number of strains occurred in Group II (13.7%), in Group IV (2.3%) and in the Miscellaneous Group (16.2%). In each group, phage patterns common to each phage type are given. The most commonly encountered phage types are: 52 (14.25%), P-68 (10.85%), 6 (7.25%), 3B (6.65%), 47C (5.4%), 29 (5.35%), 47 (5.05%) and 42B (4.55%). We have not found one strain belonging to phage type 47B. The following types were very seldom encountered: 47A (1 strain), 42E (1 strain), 51 (3 strains), 7 (3 strains) and 31 (4 strains).

Table III illustrates the results of phage typing of 861 strains isolated from patients of Montreal and Quebec City hospitals and some 137 strains received from provinces other than Quebec and from the United States. Most of the organisms (81.2%) could be typed and fell into broad phage Groups III (41%), I (15.6%) and II (5.3%). Only 4 strains belonged to Group IV. Strains lysed only by phage P-68 accounted for the largest percentage (18.%) by any single

TABLE IV

STAPHYLOCOCCI ISOLATED FROM HEALTHY CARRIERS (CHILDREN)
PHAGE TYPING AND SENSITIVITY TO PENICILLIN

Phage Group	Phage Type	No. of strains	Nose	Throat	Sensitivity to Penicillin		
					Sensitive	Moderately Sensitive	Resistant
I	29	92	66 (72.%)	26 (28.%)	90	2	—
	29A	31	24	7	27	3	1
	31	3	3	—	3	—	—
	44	3	3	—	3	—	—
	44A	6	4	2	4	2	—
	52	204	144 (70.%)	60 (30.%)	194	2	8
	52A	20	14	6	20	—	—
	Total:	359	258	101	341 (95.5%)	9 (2.2%)	9 (2.2%)
II	3A	44	27	17	36	1	7
	3B	118	96 (82.%)	22 (18.%)	118	—	—
	3C	7	4	3	7	—	—
	51	2	1	1	2	—	—
	Total:	171	128	43	163 (95.5%)	1 (0.4%)	7 (4.1%)
III	6	42	14	28	6 (14.6%)	10 (23.8%)	26 (62.%)
	7	1	—	1	—	1	—
	42B	24	15	9	12 (50.%)	—	12 (50.%)
	42C	48	40 (83.%)	8 (17.%)	47	—	1
	47	4	3	1	1	—	3
	47C	16	12	4	13	1	2
	Total:	135	84	51	79 (58.5%)	12 (8.9%)	44 (32.6%)
IV	42D	11	6	5	11 (100.%)	—	—
Other Phages	P68	77	55 (72.%)	22 (28.%)	68	1	8
	Q230	17	11	6	17	—	—
	Total:	94	66	28	85 (90.5%)	1 (1.%)	8 (8.5%)
Untypable	No lysis	338	259 (76.5%)	79 (23.5%)	319 (94.5%)	5 (1.5%)	14(4.%)
	Total:	1108	801 (72.%)	307 (28.%)	998 (90.%)	28 (2.5%)	82 (7.5%)

phage. The other phage types found were, in order of prevalence: 52, 47C, 47, 6, 42B and 3B.

Table IV shows the results obtained by phage typing of 1,108 strains isolated from young healthy carriers. Our data indicate that 67.3% of the strains were typable; that 36% of strains isolated from nose and 25.7% of strains isolated from throat were untypable. Group I accounted for 46.7%; Group II, for 22.2% and Group III for 17.5% of the strains. Staphylococci classified as type P-68 formed 7% of the total. The most common types found were 52, 3B, 29, P-68, 42C and 3A. The phage group frequency in relation to penicillin sensitivity is also described. The organisms of Groups I and II are mostly sensitive to penicillin, whereas strains of Group III are much more resistant.

Discussion

Comparing our phage typing results, which indicate that 72.6% coagulase-positive staphylococci were typable, with those of other investigators, it may be recalled that Wilson and Atkinson were able to type 60.4% of their strains by using 18 phages, whereas Fisher typed 73.5%, Blair and Carr 73.5%, Williams and Rippon about 60%, and Fusillo et al. 77%. The use of classical phages only would have permitted us to type only 60.6% of our strains. In this respect, it is noteworthy that Wahl and Fouace (34) were able to reduce the percentage of their untypable strains from 6 to 1.5% by the isolation of 13 new phages from strains untypable by classical phages. Even if some strains may be naturally resistant to phage action, it is obvious that further research for new phages is needed to aid epidemiological investigation.

Our data agree with Williams and Rippon's observations that untypable strains are more commonly found in the normal nose and throat than in lesions (30.5% of 1,108 strains and 19% of 998 strains, respectively). A difference in the degree of virulence might be responsible for this significant discrepancy.

At various times, authors have failed to establish the existence of type or types particularly pathogenic for human beings. Studying skin and respiratory tract infections in young children, Laurell and Walmark (35) concluded that no phage type is especially pathogenic but that over-all results of phage typing indicated a high incidence of a few types represented by penicillin-resistant "hospital types." Prissick (36) and Saint-Martin et al. (37) have shown that, in this Province, between 60 and 75% of hospital staphylococcal strains are penicillin-resistant. Our data show (Table III) that 41% of typable strains fell into Group III, 15.6% into Group I, 5.3% into Group II and 18.1% were of P-68 phage type. Fusillo et al. (27) reported that 74.5% of 362 penicillin-resistant strains fell into phage Group III whereas only 35% of their 123 penicillin-sensitive strains were of this Group. Our results indicate that strains isolated from healthy carriers, 92% of these being penicillin-sensitive, are classified as follows: 32.2% in Group I, 15.4% in Group II, 12.2% in Group III and only 7% of phage type P-68. Penicillin-resistant hospital types are represented, in this Province, by types 47, 47C, 6 and 42B of Group III; type 52 of Group I and type P-68. Types 52 and 47C are quite common in

both Montreal and Quebec hospitals. Other types such as 3B, 6, 42B and 47 are more often encountered in Montreal institutions; types 47C and P-68, in Quebec hospitals.

In England, Ludlam (38), Barber and Whitehead (39) found that type 52A was prevalent in hospitals as penicillin-resistant strains of infections. Allison (40) reported that type 3A is often encountered.

A review of Table IV concerned with healthy carriers indicates that such types as 29, 29A, 3B and 3A, rarely encountered in clinical infections, are rather predominant in carriers and practically all penicillin-sensitive. Phage type 52 is frequently found in both cases and healthy carriers, but strains found in carriers are mostly penicillin-sensitive. It appears that some varieties are hospital strains with high invasive power and that the remaining are so-called "wild varieties" less apt to cause infection. Some carriers of phage types 6 and 42B of Group III might have acquired them through contamination by clinical cases, since the majority of these strains are penicillin-resistant. Strains falling in phage type P-68 are predominantly found in clinical infections in Quebec City hospitals, but are also found with some frequency in Montreal patients and in carriers. Our local phage type strain Q-230 isolated from an infection in Montreal was not found in Quebec infections and this type seems to be not highly virulent, since only 17 strains, all penicillin-sensitive, were isolated from carriers.

Some phage types were very seldom encountered in this survey. For instance, type 47A was isolated only once, from a man suffering from boils. His infection must have been relatively mild since he never called to receive his autogenous vaccine. Type 42E was found once outside this province. Type 7 was found thrice: once from an healthy carrier and twice from infections in Quebec City. Type 51 was never associated with infections in this province 2 strains were isolated from carriers and 1 strain from a case outside the province. This situation of phage types which are very seldom encountered has been experienced by various workers; Williams and Rippon did not find any cultures of Rountree's type 3B. We have had the same experience of finding no cultures of Colbeck's phage type W, although this strain was responsible for an extensive outbreak of folliculitis and breast abscesses in Winnipeg, Canada. North and Christie (41) and also Barber and Rozwadoska (42) isolated from the same person penicillin-sensitive and penicillin-resistant strains of the same phage type. We have experienced the same situation with two strains from the same patient who died from staphylococcal pneumonia: the first culture isolated from sputum was penicillin-sensitive and the second, isolated post-mortem from lung abscess was resistant to penicillin.

The mode of establishment of highly virulent hospital strains is by no means elucidated, but antibiotic therapy appears to have been an agent of selection and propagation in institutions where the environment is particularly favourable for maintenance and growth. The reason why these selected strains are mostly of phage Group III might be due to a particular antigenic constitution, since a close correlation appears to exist between Cowan's serological Group III and Williams and Rippon's bacteriophage Group III.

Although widespread epidemics of staphylococcal infections are infrequent, it should be realized that these infections are endemic within most hospitals. Consequently, we feel that this method of phage typing can be used with great advantage in epidemiological studies of hospital cross-infections as well as of food-poisoning outbreaks. Thus, some knowledge will be gained of the origin and spread of hospital infections, of the relationship between strains from the patients' lesions and those found in carriers. In outbreaks of staphylococcal food-poisoning, the isolation of identical phage type organisms from specific foods, vomitus or feces of the patients and from skin lesions or nasopharynx of food-handlers is of distinct value to the epidemiologist.

Finally, phage typing can be used successfully in clinical investigations of related infections in the same patient at different periods of time. In such studies a comparison of the strains repeatedly isolated during a septicemia may be of interest, or the similarity or difference in the strains isolated from blood and those isolated in such infections as osteomyelitis, furonculosis, meningitis or abscesses. In chronic infections, phage typing might indicate to the clinician whether relapses are new infections or reinfections by the same organisms.

Summary

1. Since 1948, 2,370 strains of coagulase-positive staphylococci, isolated from hospital patients and from children considered as healthy carriers, were subjected to phage typing with bacteriophages propagated and preserved in glycerolated Tryptose medium without filtration. Of the strains examined 72.5% were typable with the available phages and 27.4% were untypable.

2. The majority of the typed strains occurred in Group III (36%) and in Group I (32%), as compared with 13.7% in Group II and 17.3% in the Miscellaneous Group.

3. Most of the hospital strains were typable (81.2%) and fell into Groups III (41%), I (15.6%) and Type P-68 (18.%). Only 4 strains belonged to Group IV (type 42D). In the Province of Quebec, no specific type appears to be responsible for infections in hospitals, except type P-68 in a Quebec City hospital.

4. Of strains isolated from healthy carriers, 67.3% were typable, of which 46.7% fell in Group I; 22.2% in Group II; 17.5% in Group III and 13.6% in other groups. Most organisms of Groups I and II are sensitive to penicillin whereas strains of Group III are much more resistant.

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Indigent Medical Care: The Needs of the Recipient

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THE indigent groups of which Dr. Milton I. Roemer* spoke in his paper are those for whose maintenance the province is responsible. I understand that in numerous cases the person over 70 applies for the supplementary allowance to qualify for the medical care which is much more valuable to him. This happens frequently also with the federal government in regard to War Veterans Allowances, the recipients of which also receive medical care. In British Columbia and Alberta comparable provision, but with less varied services, is made for these same groups and for certain Old Age Assistance cases.

In Alberta persons in receipt of widows' pensions and disability allowances are also covered. In Manitoba limited service is given to Mothers' Allowance cases. In Ontario physicians' services at home or in the office are provided for the aged in both categories, and for the blind (but not their dependents), disabled pensioners and Mothers' Allowance cases. In Nova Scotia the provision is only for the blind and for Mothers' Allowance cases.

In British Columbia and Ontario similar provision is made by the province for social aid or general assistance cases with municipalities sharing the cost.

In all other areas, medical care programs are separate from financial assistance to the indigent. Medical care may be available through the hospitals for in-patients or out-patients, through private organizations for particular conditions or diseases, through the charity of private doctors, or, in emergencies, through the medical officers of health. The variations across the country are numerous. In Prince Edward Island the hospitals receive government lump-sum grants on condition that they give free care to indigents. In Toronto the city pays for each indigent in-patient—provided he has residence, which is different from that for financial assistance—and may try to collect from him, through the courts if necessary; and also pays a grant to the clinics based on attendances. In Quebec the amount of payment is based on a schedule under the Quebec Public Charities Act, aiming at a proportion of one-third each for the province, the municipality and the agency.

Quality and Quantity of Care

We are not as concerned here about the cost and who pays for it as with the fact that medical care of some sort is generally available to the indigent. It is often said, and probably rightly so, that in our society the indigent has

*Medical care for the indigent in Saskatchewan, Canad. J. Pub. Health, 1954, 45: 460, 502

access to better medical care than has the self-supporting person in the lower income brackets. Hospitals started originally as a means of providing medical care—or at that time, at least shelter—for the poor who could not be nursed in their own homes. As medical treatment improved they became acceptable also for persons who could pay, but they have continued to provide in large measure the medical care for the poor. This has always been supplemented by the free care given by the family doctor, a natural charity when the doctor already knew the family and had perhaps provided care under more auspicious economic conditions; less natural when the poor sick person in an urban community goes to a strange doctor and asks him for free care.

It is only recently that the idea that the indigent should be provided with full and regular medical service, as in Saskatchewan, has come to be recognized. And as yet that recognition is not general. Three months ago in a discussion of health services the argument was raised that full medical care was available to everyone, since no doctor would refuse care to a sick person. Is this a satisfactory solution if our society is agreed that people should have the medical care they need, even if they cannot pay for it themselves?

Proper medical care has at least theoretically come to be recognized as a basic necessity of life. Since our form of society has increasingly accepted its responsibility for providing the basic necessities of life to those who cannot provide them for themselves, medical care is beginning to assume its position in this, side by side with food, shelter and clothing. The arguments are clearly accepted by Dr. Roemer in his presentation: on the one hand, a humanitarian philosophy; on the other, "good business". I believe that:

1. Medical care for the indigent should be available in quantity and quality equal to that available to the self-supporting person; and that

2. Medical care for the indigent should be given in such a way that it respects the dignity of the individual.

Facilities and services should be available to the sick person according to his need of such services and not according to his ability to pay for them at the time of his sickness. Dr. Roemer has noted with pride that this holds true in Saskatchewan. But, in those areas in which the hospital is the only source of medical care for the indigent, waiting rooms throng with people, sitting for hours to spend a few minutes with a doctor, perhaps not even seeing the same doctor on successive visits. One would have to be very sick indeed to be able to face the ordeal of some of the clinics. Compare them with the atmosphere and care in "well-baby clinics" in which the question of indigency does not arise. Is the sick person not affected by these conditions?

Should we expect free care for the indigent from the doctors? Social workers know how difficult it is for people to ask for help when in so doing they are forced to admit economic failure in our society in which economic independence is the mark of success. To the illness is added the necessity of begging for professional help. We have provided financial assistance in some parts of the country as a right. Yet we often let the indigent beg for medical care. And what right have we, the citizens, to expect doctors to provide free care?

I am not belittling the charitable services given by the doctors. I am just calling to your mind that the vast majority of people dislike to ask for

"charity", and that our society in many ways has frowned upon such begging. If the care of the indigent is a community responsibility, why should we encourage or permit the doctors to shoulder that responsibility for us, through free service at hospital or office? We establish pre-payment plans so that worry over bills will not add to worry over illness. Yet generally the indigent person who has been unable to participate in such plans must struggle with himself and sometimes with the authorities to get the care he needs.

Basis for Care

Medical care should be given in a way that respects the dignity of the individual. Indigency assumes a means test. A means test is interpreted by many as intrinsically damaging to self-respect and dignity. The extent to which this is necessarily true is worthy of a discussion, but since many in the community hold this view we must take it into consideration. One's financial position—at whatever end of the scale one finds oneself—is generally considered a very personal matter. When a means test is necessary it should be administered in private and with full regard for the sensitivity of the individual. Preferably, the receipt of financial assistance for the basic necessities of life should be an automatic qualification for the needed medical care, although many persons not receiving other assistance may need care as "medically indigent". But the complete separation of financial assistance and medical care in many communities means a double means test.

It is not only a matter of administrative separation. Our varying legislation often makes two eligibility tests necessary. Means tests vary for different programs. Residence requirements vary. The present need to determine who will pay, as controlled by residence requirements, is at least as frustrating, irritating and time-consuming as the means test itself. It is true that where a person is seriously ill, medical care comes first and the argument about payment later, but unless the condition is a very serious one I suspect that the question of who will pay often assumes major importance. Illness may strike a person anywhere, and has no respect for legal residence. Yet our legislation has cut up our country into so many areas of local residence that this is often a greater problem than proof of indigency itself.

The Canadian Welfare Council has recently taken up the question of medical and other care for unmarried mothers, fighting against the system which has meant that if free medical care is given the unmarried mother, the bill may be returned for payment to the small community which she has left in order to maintain her secret.

In some communities, unless medical care is "urgent", it is often difficult to persuade a municipality to permit it; a short-sighted policy saves the taxpayers money now, although the eventual cost to the community may be much greater.

I have heard it seriously raised as an argument against health insurance that the teaching hospitals would be deprived thereby of their clinical material for teaching students. I do not know how widespread this opinion is, but it assumes that indigent patients can be treated differently from paying patients, and that there is "discrimination" against them in a certain sense.

We are faced with the unfortunate fact that, although it is commonly and probably rightly asserted that the indigent person has available to him more and better medical care than have the majority of our population, it is often made available to him in ways which do not respect his dignity as an individual. It is not therefore surprising that he does not make full use of the services. Under the systems which exist in most of Canada at present—but not in Saskatchewan—he often seeks such medical care only when he is so ill that he has little choice.

Dr. Roemer comments on the heavy utilization of hospital care, and says that hospitalization is solving social as well as medical problems. This raises the whole question of chronic illness and the realized need for research, for greater social and medical planning. From a social, medical or economic point of view, a general hospital is only a "solution" to the problem of chronic illness if the care provided by that hospital is the kind of care needed by the patient. In actual fact, such care is often used because of the lack of other, more appropriate facilities. I think I am right in saying that Saskatchewan has relatively few homes for the aged, whether they are able-bodied, ambulatory but sick, or bedridden. It is now trying to encourage the development of nursing homes for persons who do not need the full facilities of a general hospital.

Chronic illness has only come into the limelight of medical interest as acute illnesses have come more under control. It is an expensive form of illness, if it entails hospitalization. It is a difficult form of illness for many families to cope with in their own homes, not only because of the expense, nursing and care, but because of housing accommodation, equipment, and the effect on the life of the family. There is a growing idea, however, that where the chronically ill person can be cared for in his own home (not only physically but through the acceptance by his relatives of him as their responsibility), his condition is likely to be better, his attitude to himself and others more positive. Various experiments have been made with home care for the chronically ill, involving the provision of equipment, home helps, hospital and auxiliary services brought to the home, and—very important—preference for hospital admission when this is necessary. There are also efforts, not too successful to date, to encourage the building of hospitals or homes for the chronically ill, with limited medical facilities and hence much more economical than long-term care in an acute hospital. These are as yet unsolved but urgent problems in Canada, in which the social work and the medical professions must collaborate closely. Problems of utilization are closely connected with problems of welfare in which the medical social worker, in the hospital and in the administration, and the social worker providing assistance in the home must play their part. This applies not only to the aged but to all cases in which hospitalization is prolonged beyond the point of medical necessity.

Our care of the aged may be regarded as humanitarian, as must also our care of the "permanently and totally disabled". Our care of other indigent groups may be regarded equally as "good business". In mothers' allowances, child welfare and social aid cases we have more possibility of preventing illness and improving health, of helping people to become less in need of

financial assistance. Many such persons have become dependent because of health or disabling conditions; hence the amount of medical care they need will be greater than that of the general population. It is in the interests not only of the individual who is dependent, but also of the taxpayer who must finance the provision made for him, that he should be provided with the best possible medical care.

To the extent that ill-health is a contributing factor in his dependency, the cause should be removed to enable him to regain independence, wherever possible. To the extent that other factors contribute to dependency, it is important that health should be maintained or improved so that he may have the strength to find a solution to other problems.

Problems

Because the dependent person has lived at a minimum subsistence level for a period of time in which medical care often took second place to shelter and food, during his losing fight for financial independence, and because the adequacy of the financial assistance he is receiving for himself and his family is often below an acceptable standard of subsistence, his health is constantly endangered. Part of the solution here is a more adequate subsistence level. The close relationship between this and the need for medical care is obvious. Unfortunately, there are instances in which a period in hospital, for example, is necessary to overcome conditions created or aggravated by poor food, poor housing, inadequate sanitation, and insufficient protection against the weather. The father has struggled to keep his job when he should have received medical treatment, because of the need to provide for his family. The mother puts off an operation because there is no one to care for the children. The child, built up in hospital, returns to deprived conditions in his home and again is admitted to hospital. These are everyday experiences for the social worker and demonstrate again the need for freely available medical care, supported by constructive welfare services.

It is interesting that in recognition of the importance of its services, Saskatchewan advertises them: a new and encouraging move.

Civilian rehabilitation, mentioned by Dr. Roemer, is being given increased emphasis in many provinces, and the new Disability Allowances will place more emphasis upon the relationship between medical care and indigency.

Medical care is an investment for the community—an investment which needs the full partnership of the health and social-work professions. Among the indigent particularly the lack of economic resources hinders the full use of medical care, except in those cases where, undesirably, medical care becomes a solution for economic problems. The will to get better, the freedom from fear about one's family, the willingness to give up the economic support which a pension based on ill health or disability may give: these are attitudes with which the social worker is familiar and with which he is trained to help. Medical care in such cases can be utilized effectively only when the health professions and the social workers work hand in hand, on the particular case and in the administration.

In any program of medical care for the indigent a partnership between the

services is essential. The doctors need to support the social workers who are striving to correct the situations which aggravate medical conditions. And the social workers must work with the doctors to render their care more effective.

The organization of welfare services, as they are divided between local and provincial governments, and the historical emphasis upon local responsibility (which is gradually breaking down), have meant in Saskatchewan the more adequate provision for the medical needs for those indigents who have become a provincial responsibility. Saskatchewan has advanced further in this than many other provinces. Since we recognize that only the larger municipalities can provide the necessary medical services, and that those in which the need is greatest are often those in which the financial ability to meet the need is least, provincial leadership and perhaps financial help is necessary. Is the indigent to be deprived of medical care because he fits into a municipal pigeon-hole rather than a provincial one? And what of that large group, the medically indigent, who are subject to more indignities because of arguments about the payment of the bills—with fewer services available to them—yet frequently driven into the indigent class because of the expenses and worry connected with the medical care they need?

In many of our developing medical care programs we are dividing our community into income groups. Those who are employed, and particularly if their employers will contribute, may be covered by voluntary prepayment plans. Those whose incomes are high can buy the services they need except when they are faced with catastrophic costs. But those in the lower income groups, the indigent and the medically indigent, where should they fit? It would seem highly desirable that they should fit into the general pattern of community services, so that they receive freely and on the same conditions the medical care available to all citizens. We have heard various plans outlined for the public as a whole and I should like to see, eventually, the indigent and the medically indigent receive their medical care in the same way as the rest of the community, the source of payment being the only difference.

Perhaps there is an analogy in the development of financial assistance under public auspices. Originally provision was made for food by giving it in kind; then came the closed voucher, given on the basis that an indigent person could not be considered responsible for choosing his own food wisely. We moved to the open voucher, feeling we needed a check on how he spent his money. And now in general, but not yet throughout Canada, we give cash.

Is there an analogy here for the development of medical services? Admittedly it is more complicated because of the variety of sources.

We formerly limited, and in many places still do limit, medical care to hospital care—the bare essentials. We have started to extend it to a greater variety of medical services. But we still demand "deterrents", such as approval from the Department. We do not yet trust the individual or the doctor to determine the care needed. The only difference between the indigent and other people is that he has not the money to pay for the care he needs. When we fully accept that, we shall make arrangements for payment so that the source of funds alone distinguishes him from other citizens. Only thus can we ensure

that there is no difference in quality or quantity and no damage to the dignity of the patient.

Dr. Roemer says medical care costs money: the lack of it costs more—in heavier but delayed medical costs, in wastage in productivity, in the public support of the deprived people. We must put into practice the philosophy to which we so often give lip service, that the health and welfare of the people in the community, in so far as they cannot be advanced by individual effort, are the responsibility of the community to its members.

Canadian Journal of Public Health

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DIPHTHERIA TOXOID IN CANADA

IT is now more than 30 years since the late Dr. J. G. Fitzgerald, Connaught Medical Research Laboratories, introduced diphtheria toxoid into Canada, shortly after its development by Ramon of the Pasteur Institute in Paris.

The travail which accompanied its introduction is now all but forgotten. There was the simple but sobering fact that toxoid derived from toxin by the action of formaldehyde was indistinguishable from toxin save that it was non-toxic, and hence the alarming possibility of a fatal mistake was always present. And then there was the question of the mode of action of formaldehyde on toxin. Certain chemical reactions of formaldehyde are reversible. Was it possible that the toxin-formaldehyde-toxoid reaction was of this type and that toxoid could be transformed into toxin? A great deal of thought and work were expended on this question. There was indeed suggested evidence that reversibility might occur. For example, it was found that the intradermal reaction elicited by diphtheria toxoid in certain individuals could be neutralized in part by antitoxin (horse) mixed with the toxoid before injection (1). These findings seemed to conform to the very definition of diphtheria toxin and hence to suggest the obvious and very disturbing possibility that in some individuals toxoid could be converted to toxin. Then there was the observation curious at the time, that guinea pigs injected with incompletely detoxified toxin developed paralysis before death and showed at the time of death appreciable levels of diphtheria antitoxin (1). Here were guinea pigs which had become actively immune and which nevertheless died with symptoms of diphtheritic paralysis. Was it possible that antitoxin was not effective in preventing disease? One can now give reasonable explanations for these odd phenomena but when first observed they were very puzzling and very disturbing.

After innocuity had been established and toxoid was made available, McKinnon and Ross showed that diphtheria toxoid was effective in preventing diphtheria. These investigators analyzed the results of inoculation with toxoid in school children in Toronto for the years 1927 to 1932. Among 46000 children given three doses of toxoid, the diphtheria rate was only one-tenth of that among school children who had not received toxoid. That is, toxoid had effectively protected 90 per cent of those inoculated. This is the first instance in which a non-living antigen had been shown, beyond any question of doubt,

to be effective in preventing disease. This proof of the efficacy of toxoid is in no way affected by the observation that morbidity and mortality from diphtheria has, in certain places fallen in recent years, for reasons not associated with specific measures of prevention. And further because diphtheria toxoid had been shown to be an effective antigen in preventing disease, a validity and a reality were given to studies based on antitoxin titrations and on Schick test findings.

Let it be said here that the Schick test is a useful and a reliable test. Criticism and condemnation of it have been made but these have arisen mainly because of faulty test materials, because sometimes the toxin was unstable and under strength and because of inadequacy of the heated-toxin control. In Canada suitable Schick test toxin and control have been available for years.

The work of the late D. T. Fraser and his colleague F. O. Wishart on the efficacy of diphtheria toxoid in various forms is too well known to require elaboration here. In the laboratory also, there was the outstanding work of Edith M. Taylor on diphtheria toxin production which gave toxins of higher potency than any attained heretofore; the work of C. O. Seibenmann on the important matter of testing and of P. J. Moloney and M. D. Orr on purification and reactivity of toxoids.

In recent years L. B. Holt in England has developed a new toxoid product of high immunizing activity, namely purified diphtheria toxoid adsorbed on aluminium phosphate. Alum precipitated toxoids somewhat analogous to Holt's toxoid have been available for a number of years. All these insoluble aluminium salt-toxoids possess certain advantages and certain disadvantages as compared with fluid toxoid. Our attitude toward this type of insoluble antigen has tended to be conservative. It is an attitude of open-mindedness which implies neither condemnation of the product nor indifference toward it.

A combined antigen consisting of a mixture of aluminium phosphate-toxoid with pertussis vaccine has been advocated and extensively used. It is interesting to note however that Bousfield and Holt (2) in a recent paper from England, where this mixed antigen was first used, give preference now to the simple mixture of pertussis vaccine and fluid diphtheria toxoid. And in their paper they give evidence of the high immunizing activity of the diphtheria component of the mixed antigen. In the words of the authors: "We are convinced that the required immunological standard is fully achieved by the administration of three spaced injections of plain purified toxoid with pertussis vaccine." It is gratifying to have independent approval of the type of mixed antigen which has been used in Canada for a number of years but which is now superseded by a more useful mixed antigen consisting of pertussis vaccine, fluid diphtheria and fluid tetanus toxoids.

Diphtheria toxoid has rendered a magnificent service to Public Health in Canada. It is to be hoped that the very effectiveness of toxoid will not lull the public into a false sense of security.

P. J. Moloney

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NEWS

Alberta

THE FORTY-THIRD ANNUAL MEETING of the Canadian Public Health Association will be held in conjunction with the Alberta Public Health Association meeting on September 6th to September 8th at the Macdonald Hotel, Edmonton.

The Alberta Public Health Association is delighted with the opportunity of acting as host to their friends across Canada. An excellent program is being prepared and a tentative outline will be presented in the near future.

A wide variety of accommodation is available and will be listed shortly for the benefit of our members.

This is Golden Jubilee year in Alberta, celebrating the formation of the province on September 1st, 1905. Many festivities are planned throughout the summer and fall to mark this memorable occasion. We welcome this opportunity for our members to become better acquainted with the history of Alberta and to show them what our citizens have accomplished in that "First Fifty Years".

Saskatchewan

DR. GEORGE D. SOTIROFF, a native of Bulgaria, was appointed research economist with the Research and Statistics Branch in December. Born in Sofia, he studied at the University of Sofia, at the Graduate Institute of International Studies in Geneva, and at the University of Fribourg in Switzerland where he obtained his Ph.D. in economics and political science. Dr. Sotiroff became research assistant on the staff of the League of Nations in 1936 and, during the war, acted as economic expert to the International Red Cross where he was in charge of the allocation of relief to war-stricken areas in Europe. In 1947, he joined the Secretariat of the United Nations as social affairs officer and, later on, also became secretary of the United Nations Population Commission. He was elected life fellow of the Royal Economic Society, London, in 1952. Dr. Sotiroff's publications include numerous studies, articles, and book reviews in English, French, and German on statistics and economic theory and history. He is also responsible for publishing a new (third) edition of J. C. L. Simonde de Sismondi's classical work "New Principles of Political Economy or of Wealth in its Relation to Population," the first volume of which appeared in 1951 and the second two years later.

AN ACCIDENT-REPORTING PROJECT has been initiated in the public schools of the rural municipality of Lumsden. This municipality, which is adjacent to the city of Regina and extends for some 30 miles north and west, is the demonstration area for safety education of the Division of Health Education. This program is being conducted in cooperation with the medical health officer of the Regina rural health region, and the actual activity is the work of a voluntary Lumsden and District safety council. Health educators serve as consultants. The accident-reporting plan is intended primarily as a teaching device. As part of a wider educational program in the community, it has been introduced to make children acutely aware of safety hazards existing in their immediate environment. At the same time, the reports will give some information on the types of accidents which occur in a largely rural community. A realistic approach to accident prevention has been made in the Moose Jaw health region, where an analysis has been made of 100 non-fatal accidents reported in a six-week period. A community safety committee has been proposed.

Manitoba

AN INSTITUTE OF annual interest to public health nurses in Manitoba was conducted by the School of Nursing Education, University of Manitoba, December 28 to 30, 1954, inclusive. This Institute is planned jointly with the nurses of the Manitoba Department of Health, the Winnipeg Health Department and the Victorian Order of Nurses. One hundred and fifty three nurses from these three health services and others who are in related nursing services, were registered for the course. It was sponsored by the Manitoba Department of Health and was conducted through the Department of Extension and Adult Education of the University of Manitoba.

The program centred upon nursing care of the ageing in accord with new developments in health services for the senior members of the population of Manitoba and the new responsibilities which public health nurses will have in the implementation of such services.

The purpose of the Institute was to lay a general foundation for further study of the nursing needs of the ageing and ways in which nurses might improve and increase their service to this group. The program was divided between presentations by special speakers and group discussion among the members of the Institute, based upon individual preparation made, experience, and application of ideas coming out of the program.

Special topics for discussion included: legislation regulating the facilities for care of the aged and infirm in institutions and boarding homes, the essentials of good nursing care of the aged in hospital, in nursing homes and in their own homes, a report on the work of the Provincial Committee on Rehabilitation of the Disabled and on the program envisioned in Canada for rehabilitation, community responsibility to meet the particular needs of the ageing, ideas for modification of homes and institutions for the safety and comfort of the aged, special medical needs of the ageing, and nutritional needs of the aged.

Plans are going forward for a similar Institute to be held at the same time next year.

Ontario

THE MINISTER OF HEALTH, the Hon. Mackinnon Phillips, M.D., has announced the appointment of Dr. B. H. McNeel, Superintendent of the Ontario Hospital, St. Thomas, as director of Community Mental Health Services for the Province. Dr. McNeel is now stationed in Toronto, attached to the Mental Health Division of the Ontario Department of Health.

DR. C. A. CLELAND, Superintendent of the Ontario Hospital, Toronto, is replacing Dr. McNeel at St. Thomas. Dr. D. O. Lynch, Superintendent of the Ontario Hospital, Kingston, will replace Dr. Cleland at Toronto. Dr. C. H. McCuaig, Professor of Psychiatry at Queen's University, has been appointed Superintendent of the Ontario Hospital at Kingston.

Copies of the report of the Ontario Health Survey Committee may still be obtained free of charge by writing to the Publicity Officer, Ontario Department of Health, Parliament Buildings, Toronto, 2.

THE SCHOOL HEALTH SECTION'S program at the Ontario Educational Association Convention will be of greater interest to health workers this year.

On Tuesday morning, April 12th, a joint meeting will be held with the Home and School Section on "Health and Learning", a symposium featuring Dr. A. L. Morgan, Chief of the Department of Ophthalmology, Dr. J. B. Whaley, Chief of the Department of Ear, Nose, and Throat, Dr. Wm. A. Hawke, Chief of the Department of Psychiatry and Neurology, Hospital for Sick Children, and Mr. Wm. J. Quinn, Supervisor of Physical and Health Education, Toronto Board of Education. This meeting will be held at the Royal York Hotel, Toronto.

DR. A. J. RHODES, Director of Research, Hospital for Sick Children, will speak at the School Health Section on Wednesday morning, April 13th, on "Recent Advances in Some Infectious Diseases". Dr. W. R. Keeler, Hospital for Sick Children, will speak on "Behaviour Problems associated with Organic Brain Disturbance". The meeting will be held in the Music Room, Hart House, University of Toronto.

There will be speakers of interest to public health workers at the meetings of other sections, particularly the Physical and Health Education Section, and the Guidance Section. On Monday, April 11, Dr. H. Ebbs, Director of the School of Physical and Health Education, will speak on "Health Education—Fact or Fantasy".

For further information write Dr. C. G. Stogdill, Director of Child Adjustment Services, Toronto Board of Education, 155 College St., Toronto.

New Brunswick

DR. J. A. MELANSON and Dr. A. M. Clark, chief and assistant chief medical officers attended the 17th annual meeting of the Health Planning Committee of the Maritime Provinces and Newfoundland, held in Halifax from January 11 to 13. Also in attendance was Dr. R. R. Prosser, Director of the Mental Health Division.

MR. A. J. CAMERON, Director of Sanitary Engineering Division, announced that five sanitary inspectors in the Province had

successfully completed examinations conducted by the Canadian Public Health Association, leading to Certification in Sanitary Inspection (Canada). The successful candidates are Mr. Anaclet Noel, Gloucester County, Mr. Allan MacKenzie, Northumberland County, Mr. Gerard Richard, Kent County, Mr. Arthur Burley, Carleton County, and Mr. Lucien Ouellet, Madawaska County.

MISS EDITH WARMAN, Public Health Nurse, Carleton County has returned to duties, having recovered from the effects of an unfortunate car accident last October. Miss Corinne Pichette, Public Health Nurse, Madawaska County has returned to work after an absence of six months due to illness.

MISS MARGARET BRANCH and Miss Apalline Robichaud, Public Health Nurses are attending a course in Mental Hygiene and Public Health at Dalhousie University from Jan. 11 to March 18, 1955.

Nova Scotia

THE SEVENTEENTH ANNUAL MEETING of the Health Planning Committee of the Maritime Provinces and Newfoundland was held at the Province House, Halifax, on January 11th, 12th and 13th. A wide variety of public health matters, of common interest to the four provinces, was discussed at length. Meetings were held with representatives of the Maritime School of Social Work and Dalhousie University, having particular reference to training programs in social work, post graduate nursing, psychiatry and psychology, jointly participated in by the provinces.

Among other subjects taking up the attention of the Committee were Child and Maternal Health Services, Mental Health, Laboratory Services and Medical Rehabilitation.

The official Committee Members present were Doctors J. A. Melanson and A. M. Clarke, New Brunswick; Doctors O. H. Curtis and J. H. Shaw, Prince Edward Island; Dr. J. M. McGrath, Newfoundland; Doctors C. B. Stewart and G. G. Simms, Nova Scotia.

Taking part in the pertinent discussions were the Directors of the Mental Services of the Atlantic Provinces, Dr. R. R. Prosser, New Brunswick; Dr. A. J. Murchison, Prince Edward Island; Dr. C. H. Pottle, Newfoundland and Dr. C. S. Marshall, Nova Scotia. In connection with Laboratory Services, Doctors R. A. H. MacKeen, New Brunswick, Dr. J. E. Josephson, Newfoundland and Doctors D. J. Mackenzie and O. C. MacIntosh, Nova Scotia, were present. Dr. E. L. Eagles, Director of Child and Maternal Health Services for Nova Scotia, led the discussion on that topic.

Dr. G. E. Wride, Principal Medical Officer, National Health Grants and Dr. C. A. Roberts, Principal Medical Officer, Director of Health Insurance Studies, attended the meeting on invitation.

The Department of Public Health were hosts to the meeting and gave an official luncheon at the Lord Nelson Hotel. Dr. J. S. Robertson, Deputy Minister of Public Health for Nova Scotia was the Chairman.

MRS. JESSIE DOUGALL has joined our staff as Public Health Nurse in the Dartmouth area. Mrs. Dougall worked with us some years ago in the Cape Breton district when she was Miss Jessie MacIvor. Miss Pearl Rumley and Miss Flora Sampson are in training as public health nurses in the Bedford and Sydney areas respectively.

MISS MARGARET C. MASTERS, R.N., has been appointed nursing consultant to the Division of Child and Maternal Health. Miss Masters is a graduate of Guy's Hospital, London, both in general nursing and in midwifery. She also received a midwife's teaching diploma from the Royal College of Nursing. In Canada Miss Masters did further study and has held teaching posts in both graduate and undergraduate schools of nursing. Her appointment will further extend the program of child and maternal health in Nova Scotia.

EMPLOYMENT SERVICE

Advertisements regarding "positions available" and "personnel available" will be published in from one to three consecutive issues, depending upon the requirements of the agency or person concerned. They are limited to seventy words or less, with a confidential box number if desired. There is no charge for this service to members of the Association. Health agencies are charged a flat rate of $10.00 for the advertisements (up to four consecutive issues) and for the service. The rate for non-members is $5.00. The service includes confidential clearing of information between prospective employer and employee if desired.

Public Health Nurses required by Department of Health, City of Kingston. Salary range in effect, five day week, pension and hospitalization plans available. Apply to Medical Officer of Health, City Hall, Kingston. 2–5

Public Health Nurses required for generalized program with health unit, liberal car allowance and good personnel policies. Apply to R. S. Peat, M.D., Medical Officer of Health, Stormont, Dundas and Glengarry Health Unit, 104 Second Street West, Cornwall, Ontario. 2–3

Public Health Nurse required by Board of Health, Town of Ajax. Salary range in effect; pension and hospitalization plans available; five-day week. Apply stating age, qualifications, experience and references to Mr. B. C. Falby, Secretary, Board of Health, Box 9, Ajax, Ontario.

Sanitary Inspector required for health unit. Liberal transportation arrangements and good personnel policies. For further details apply to R. S. Peat, M.D., Medical Officer of Health, Stormont, Dundas and Glengarry Health Unit, 104 Second Street West, Cornwall, Ontario. 2–3

Sanitary Inspector, qualified, required by the Department of Health, City of Kingston. Salary range in effect, transportation provided, five day week. Pension and hospitalization plans are available. Apply to Medical Officer of Health, City Hall, Kingston, Ontario. 2–4

Sanitary Inspector, Grade 3, required by the West Kootenay Health Unit, Trail, B.C. Salary, $281 to $399 per month. Must have a certificate in Sanitary Inspection (Canada) and four years experience. Apply Chairman, Civil Service Commission, Parliament Buildings, Victoria, B.C.

Sanitary Inspector, Grade 1 or 2, required by the Cariboo Health Unit, Quesnel, B.C. Starting salary, $245 to $260, depending on experience, rising to $315 per month. Civil Service cumulative sick leave plan and pension plan; car allowance or car provided. Apply Chairman, Civil Service Commission, Parliament Buildings, Victoria, B.C.

Sanitary Inspector, qualified, C.S.I.(C)., experienced in full general program, desires position with either health unit or private concern. References available. Own car. Box 26, Canadian Public Health Association, 150 College Street, Toronto 5, Ontario. 2–4